FEATURES

The principle strengths of CASCADE are that it is:

- **Reliable; built in back-up features and automatic monitoring of failures.**
- **Accessible; full system availability at home.**
- **Fast; automated displays aid monitoring.**
- **User-friendly; short, easy commands and clear, informative displays.**
- **Economical; low capital and revenue costs.**
- **Versatile; linked to telex/fax.**
- **Flexible; structured to make incorporation of new features easy.**
- **Extendable; easily adapted for other catchment areas.**

The National Rivers Authority consists of ten regions, of which Thames Region is one. Our aim is to safeguard the total river environment, not just the many rivers, streams and lakes in the region but also the quantity and quality of underground water. It is an area of great diversity, ranging from rural Oxfordshire and Wiltshire through the high-tech industry of the Thames Valley and the urban spread of London.

Carrying out our activities over so wide and varied an area provides a constant challenge to our 1,300 employees, based at various site offices throughout the Region and at Headquarters in Reading.

NRA

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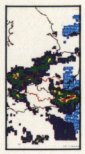
CASCADE: A Catchment Assessment System Concerned with the Accurate Dissemination of Effective flood warnings.

FLOOD FORECASTING AND MONITORING

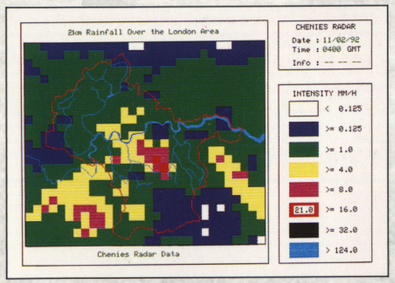


NRA

In the Metropolitan Area of London and the adjoining urban areas, the disruptive and damaging effects of flooding are potentially very high. About ten thousand properties are at risk of flooding from a one in fifty year flood from the tributaries of the Thames. Possible damage is estimated at over £20 million at 1991 prices. This makes the provision of reliable, accurate and timely flood warnings especially important. The degree of urbanisation also results in catchments having a rapid response to rainfall. As a consequence, flood warning becomes particularly challenging as there is often very little time for the issue of a warning before the onset of flooding. Because of this, a flood warning system has been developed to include a large element of automation as well as operational simplicity and reliability. This enhances the ability to identify imminent floods and to disseminate flood warnings quickly.

CASCADE

CASCADE is a flood forecasting and warning system for non-tidal rivers developed in-house by the Thames Region of the National Rivers Authority and its predecessor authorities. It is used within the London area, and the catchments of the rivers Lee and Roding which drain parts of Bedfordshire, Hertfordshire and Essex. Flood warning for these catchments is carried out



from the Flood Warning Centre at Waltham Cross in Hertfordshire. The system gathers data from a network of 55 telemetering raingauges and 70 river level gauging stations. Also rainfall data are received from the London Weather Radar situated at Chenies in Buckinghamshire to the northwest of London. Heavy Rainfall Warnings and longer term weather forecasts from the London Weather Centre are also received via an integrated telex link. These data are made available to forecasters through terminals based within the Flood Warning Centre at Waltham Cross and in Flood Duty Officers own homes. This allows a developing flood situation to be monitored at any time of the day or night.

THE SYSTEM

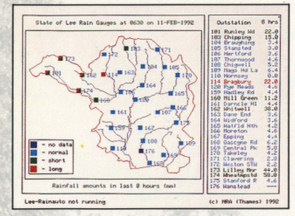
CASCADE has at its heart a Digital VAX 4000-200 computer. This directly receives and processes radar rainfall data from the London Weather Radar and FRONTIERS rainfall forecasts from the Meteorological

Office at Bracknell. It controls also a number of Master Stations which gather data from the network of telemetry outstations. Data can be obtained from all the telemetered raingauges and river level gauging stations within 10 minutes. The outstations alert the VAX computer when either critical rainfall rates or river levels are attained.

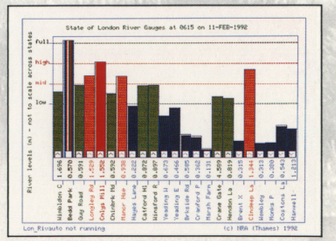
These alarms are either directed to specified terminals or to appropriate telephone numbers, including mobile telephones and pagers, via an Autodialler. In this way, the Flood Duty Officer is very rapidly alerted to a developing flood situation. The system also automatically monitors its own performance and alerts the Duty Officer of any critical hardware, software or communications failures.

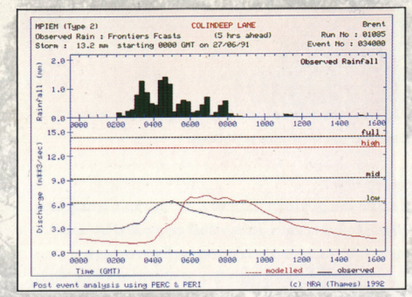
DISPLAYS

Displays of rainfall and river level data are immediately available in many formats. As data are received, displays are automatically updated without user intervention. Weather radar data are presented in several formats with



river networks and catchment and regional boundaries superimposed; again with new data appearing automatically on displays. Radar rainfall data may be displayed either in 2km and 5km grid format or as sub-catchment totals.





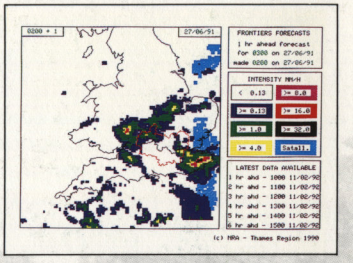
TELEX & FAX

Incoming Heavy Rainfall Warnings and longer term weather forecasts are automatically routed from a telex machine into predetermined directories on the VAX computer. This enables Duty Officers at home to view their contents immediately. Telex and fax messages can also be issued from terminals either at home or within the office. Menu-driven procedures assist the issue of flood warnings to the police and other external organisations whose details are stored on computer against appropriate river reaches. By nominating a particular river reach or reaches, warnings can be created and issued by the VAX computer automatically. This facility radically reduces the amount of time which is normally incurred when each telex message must be typed and issued manually.

DEVELOPMENTS

CASCADE has been developed to incorporate several new initiatives in flood forecasting:

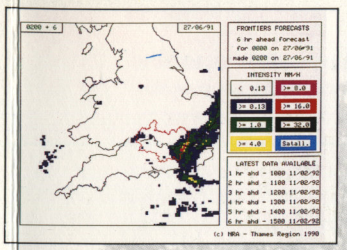
Radar Calibration:
Rainfall radar images are calibrated on the VAX computer in real-time by reference to rainfall recorded by the network of telemetering raingauges, following a method developed jointly with the Institute of Hydrology. This enables the accuracy of raingauge data to be combined with the good spatial characteristics of radar rainfall data.

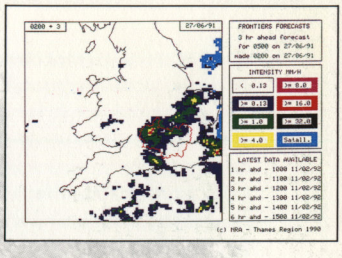


FRONTIERS Forecasts:
Procedures have been developed for the on-line assessment of FRONTIERS, a Meteorological Office product which uses real-time radar, satellite data and forecast wind fields to produce nationwide rainfall forecasts out to 6 hours ahead on a 5km grid.

Local Rainfall Forecasting:
A more detailed local forecasting procedure has been developed in conjunction with the Institute of Hydrology. This uses recent rainfall movement to predict precipitation up to 2 hours ahead on a 2 km grid.

Flow Forecasting:
CASCADE accommodates flow forecasting models running in real-time using either rainfall data from raingauges, weather radar data (locally calibrated or uncalibrated), FRONTIERS forecasts or locally forecast





rainfall, or a combination of these. In turn, these flow forecasts are converted to level, and hence flood, forecasts.

THE FUTURE

Developments planned for the future include:

- the creation of rainfall alarms based on high rainfall intensities detected by weather radar or forecast by one of the rainfall forecasting procedures. This will help identify convective rainfall events, such as summer thunderstorms, which are the cause of many floods in the London urban area.

- the automatic initiation of outstation interrogations and flow forecasting model runs based on heavy rainfall alarms or rapidly rising river levels.

- the assessment of new detection methods which use satellite data to identify severe storms, thus enhancing their early detection.

All of these initiatives are designed to improve the National Rivers Authority's ability to issue timely, reliable and accurate flood warnings especially in London's fast responding urban catchments.